PRELIMINARY INDUSTRY CHARACTERIZATION:
SURFACE COATING OF PLASTIC PARTS AND PRODUCTS

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

1.0 OVERVIEW OF INITIAL PHASE AND NEXT STEPS FOR MACT DEVELOPMENT

Under section 112(d) of the Clean Air Act (the Act), the U.S. Environmental Protection Agency (EPA) is developing national emission standards for hazardous air pollutants (NESHAP) for the plastic parts surface coating source category. The EPA is required to publish final emission standards for hazardous air pollutant (HAP) emissions from the plastic parts source category by November 15, 2000. For this category, national volatile organic compound (VOC) rules or control techniques guidelines (CTG) under section 183(e) are being developed on a similar schedule.

The Act requires that the emission standards for new sources be no less stringent than the emission control achieved in practice by the best controlled similar source. For existing sources, the emission control can be less stringent than the emission control for new sources, but it must be no less stringent than the average emission limitation achieved by best performing 12 percent of existing sources (for which the EPA has emissions information). The NESHAP are commonly known as maximum achievable control technology (MACT) standards.

The MACT standards development for the plastic parts industry began with a Coating Regulations Workshop for representatives of EPA and interested stakeholders in April 1997 and continues as a coordinated effort to promote consistency and joint resolution of issues common across nine coating source categories.[1] The first phase was one in which EPA gathers readily available information about the industry with the help of representatives from the regulated industry, State and local air pollution agencies, small business assistance providers, and environmental groups. The goals of the first phase were to either fully or partially:

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[1] The workshop covered eight categories: fabric printing, coating and dyeing; large appliances; metal can; metal coil; metal furniture; miscellaneous metal parts; plastic parts; and wood building products. The automobile and light duty truck project was started subsequently.

- Understand the coating process,
- Identify typical emission points and the relative emissions from each,
- Identify the range(s) of emission reduction techniques and their effectiveness,
- Make an initial determination on the scope of each category,
- Determine the relationships and overlaps of the categories,
- Locate as many facilities as possible, particularly major sources,
- Identify and involve representatives for each industry segment,
- Complete informational site visits,
- Identify issues and data needs and develop plan for addressing them,
- Develop questionnaire(s) for additional data gathering, and
- Document results of the first phase of regulatory development for each category.

The information summarized in this document can be used by States that may have to make case-by-case MACT determinations under sections 112(g) or 112(j) of the Act. The initial phase of the regulatory development focused primarily on literature and database searches, stakeholder contact, and site visits. The main goal of the initial phase of data collection was to establish a foundation necessary for further MACT development by gaining an understanding of the various coating processes and identifying typical emission points and emission reduction techniques. This document represents the conclusion of that phase of rule development.

This document includes a description of the emission control technologies EPA identified that are currently used in practice by the industry and that could serve as the basis of MACT. Within the short time-frame intended for this initial phase, however, only limited data were collected. The information summarized in this memorandum was collected prior to July 31, 1998. Additional information will be collected and considered before the plastic parts surface coating standards are promulgated.

During the next phase, EPA will continue to build on the knowledge gained to date and proceed with more focused investigation and data analyses. We will also continue our efforts to coordinate cross-cutting issues. We will continue to identify technical and policy issues that need to be addressed in the rule making and enlist the help of the stakeholders in resolving those issues.

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Section 2.0 summarizes this phase of regulatory development, lists the data collection activities, and describes the stakeholder participation. Section 3.0 contains a description of the plastic parts and products surface coating source category, and it includes the following: a profile of the industry, a description of the coating processes, characterization of emissions and control technologies, a discussion of source category scope, and a summary of existing Federal and State regulations. Section 4.0 lists the references cited in this document. Also, note that appendix A contains a list of defined terms. This list is for the purposes of this document only and it should not be considered binding or final in any regulatory sense.

2.0 SUMMARY OF THE INITIAL PHASE OF DATA COLLECTION

2.1 EXECUTIVE SUMMARY

During the initial phase of data collection, EPA gained an understanding of applicable control techniques, including add-on control devices such as thermal incinerators and pollution prevention measures such as coating reformulation. As a result, EPA identified facilities to survey and industry segments, and characterized the processes and emission points. This process has raised issues of scope and overlap with other regulations for further investigation.

The EPA's data collection efforts resulted in identification of approximately 500 plastic part coating facilities. The EPA was not able to determine how many of the identified sources are major sources. Data collected from database searches, State and local air pollution control agencies, site visits, the Internet, and stakeholder input suggest four distinct industry segments for purposes of setting the MACT floor. These include the following:

- Automobile and light duty truck parts,
- Heavy duty truck parts,
- Business machine parts, and
- Miscellaneous parts.

The EPA has identified potential overlap between the plastic parts surface coating source category and existing Federal rules or the other surface coating rules under development. These potentially overlapping Federal rules include:

- Miscellaneous Metal Parts Surface Coating NESHAP,

- Boat Manufacturing NESHAP,
- Reinforced Plastic Composites Manufacturing NESHAP,
- Automobile And Light Duty Truck Assembly Coating NESHAP,
- Large Appliances NESHAP,
- Metal Furniture NESHAP,
- Miscellaneous Industrial Adhesives NESHAP,
- Aerospace NESHAP,
- National Emission Standards For Wood Furniture Manufacturing, And
- National VOC Emission Standards For Automobile Refinish Coatings.

The EPA does not intend to cover operations under the plastic parts surface coating NESHAP that are already subject to emission reductions under another NESHAP.

The EPA is considering whether the scope of the source category needs to include co-located ancillary operations necessary to the surface coating process (such as surface preparation with solvent containing materials, coating storage and mixing operations, and solvent use in equipment clean-up). The issue of considering these ancillary operations only if they are co-located with surface coating operations has yet to be addressed. In addition, EPA is considering whether the scope should include treatment of non-traditional or special-case coating operations, such as adhesives application or touch-up coating.

The EPA identified characteristics of the industry that may impact determination of MACT. Specifically, the rule may need to focus on the systems of compatible coatings so that, for example, it does not require a base coat that is incompatible with a top coat. In addition, the rule may need to address the dependency of the coating selection on the substrate type, part characteristics, coating application methods, and performance specifications of the final part.

The next phase of regulatory development will focus on data collection through an industry-wide survey and additional site visits. The continuing data collection will be focused on providing the data necessary to address the issues identified during the initial data gathering process. This data will then be used to establish the MACT floor and to evaluate potential control options that are more stringent than the floor. The EPA encourages the continuing participation by stakeholders during the MACT process.

2.2 DATA COLLECTION ACTIVITIES

2.2.1 <u>Goals</u>

During the initial phases of the data collection process, it was important to develop an understanding of the various coating processes and to identify typical emission points and emission reduction techniques. The data collection goals set by EPA focused on establishing a foundation needed for MACT development (understanding emission characteristics and evaluating the level of control in the industry). Some general information needs were identified early in the process, including:

- Determining current applicable coating standards and means of compliance,
- Identifying a significant portion of the affected industry facilities, and
- Characterizing the wide variety of coatings (including adhesives, sealants, and caulks) in use.

To characterize the multitude of coatings in use in the industry, EPA established the objective to gain an understanding of the practical and site-specific constraints relevant to the coatings applied and to the emission controls (such as process time and space requirements, finished product quality and appearance, and variability in the size, shape, and other characteristics of the parts coated). Understanding the coating techniques, types and amounts of coatings used, emission points, and any VOC and HAP emission reduction technologies and control technologies was identified by EPA as a goal of the data collection effort.

2.2.2 <u>Sources</u>

The EPA's Alternative Control Techniques (ACT) document, *Surface Coating of Automotive/Transportation and Business Machine Plastic Parts*, provided background information and served as a starting point for the data collection activities.[1] The ACT document was completed in 1994 and describes the industry as it existed in the early 1990's. (See appendix B for a synopsis of the ACT document.) Much of EPA's effort in data collection consisted of updating the ACT document to reflect changes since it was written. The EPA conducted a literature search of current books, trade journals, engineering handbooks, industry and trade association home pages on the Internet, and other EPA surface coating documents, in addition to consulting the following sources of information:

- EPA, State, and local air pollution databases,
- State and local air pollution control agencies,
- Site visits, and
- Internet information collection.

Databases. The EPA collected available information on the plastic parts surface coating industry from several databases. The EPA used the Standard Industrial Classification (SIC) and Source Category Classification (SCC) Codes listed in Tables 2-1 and 2-2, respectively, in the searches of databases organized by SIC and/or SCC Code. (As discussed in the bullets that follow this paragraph, database searches by SIC Code were of limited usefulness.) None of these databases provided a complete emissions profile of the plastic parts coating industry. The search did provide initial indications of some of the chemical species emitted and their magnitudes, as well as the names and locations of plastic parts coating facilities. The EPA searched for information in the following databases:

- Aerometric Information Retrieval System (AIRS). The EPA searched this EPA database system for process descriptions and HAP and VOC emissions data on the plant level and on the individual process level. Plant level data were obtained from AIRS by SIC Code. These data proved to be of limited use for the plastics coating industry because there are no codes for secondary operations of coating plastics. A facility that manufactures plastics, but does not coat the substrate, will likely use an SIC Code for the plastics manufacturing process, as will a facility that performs both operations.

  And although EPA also obtained data from AIRS on an 8-digit SCC Code basis (individual industrial processes), EPA could not compare process data from AIRS among the identified facilities because of a lack of consistency in process naming

TABLE 2-1. STANDARD INDUSTRIAL CLASSIFICATION CODES FOR SURFACE COATING OF PLASTIC PARTS

SIC Code[1]	Includes Manufacturing of:
3086	Plastic foam products
3089	Plastic products not elsewhere classified
3537	Industrial trucks, tractors & trailers
3571	Electronic computers
3573	Computer terminals
3577	Computer peripheral equipment
3578	Calculating and accounting machines
3579	Office machines
3643	Current carrying wiring devices
3647	Vehicular lighting equipment
3711	Motor vehicles and passenger car bodies
3713	Trucks and bus bodies
3714	Motor vehicle parts and accessories
3715	Truck trailers
3716	Motor homes
3751	Motorcycles, bicycles, and parts
3799	Transportation equipment
3821	Laboratory apparatus and furniture
3931	Musical instruments
3942	Dolls and stuffed toys
3944	Games, toys, children's vehicles
3949	Sporting and athletic goods
3961	Costume jewelry and novelties
3993	Signs and advertising specialties

[1] Searches by SIC Code proved to be of limited use for the plastics coating industry because there are no codes for secondary operations of coating plastics. A facility that manufacturers plastics, but does not coat the substrate, will likely use an SIC Code for the plastics manufacturing process. The same code will likely be used by a facility that performs both operations.

TABLE 2-2. SOURCE CATEGORY CLASSIFICATION CODES FOR SURFACE COATING OF PLASTIC PARTS

SCC Code	Includes:
402-xxx	Surface coating operations
402-001 through 402-007	Surface coating application - general
402-008	Coating ovens
402-009	Thinning solvent - general
402-016	Automobile and light duty trucks surface coating
402-022	Plastic parts surface coating
Area sources:	
A24-01xxx	Solvent utilization, surface coating
A24-01035	Plastic products surface coating
A24-01055	Machinery and equipment surface coating
A24-01065	Electronic and other electrical equipment surface coating
A24-01070	Motor vehicles surface coating
A24-01090	Miscellaneous manufacturing surface coating
A24-01990	All surface coating categories

schemes. However, the EPA was able to extract facility names and contact information for facilities that are likely to be coating plastic parts, but was unable to obtain consistent emissions data.

- Toxic Release Inventory (TRI). The TRI system contains data from individual plants on estimated annual releases for the list of chemicals regulated under SARA Title III section 313. Since TRI identified processes by SIC Code, it has the same limitations as AIRS. In addition, the TRI database only contains TRI reportable compounds, which does not include all HAP and VOC species, and it only provides facility-wide emissions estimates. The TRI database was used to identify facilities reporting SIC Codes which are commonly used by plastic parts coating facilities.

- Source Test Information Retrieval System (STIRS). From the STIRS database, the EPA extracted source test reports from State and local air pollution control agencies. The information was obtained for various industrial processes. The "Evaporative Loss Sources" list for the Industrial Surface Coating category was searched for information on plastic parts coating facilities. The test data did not provide emissions estimates for either the facility or for the coating processes, nor did they provide descriptions of the coating operations. The EPA was able to use the STIRS reports to identify some additional facilities that may perform surface coating of plastic parts.

- ENFLEX. The EPA used the ENFLEX database, maintained and updated annually by Information Handling Services -- Environmental Information, Inc., to extract the full text of current environmental regulations. The EPA obtained Federal and State rules, which were then searched to locate States that have specific coating regulations. Discussion of relevant Federal and State rules is contained in section 3.0 of this document.

State and Local Agencies. Through the database searches, EPA identified several States where plastic part coating operations are concentrated, thus allowing prioritization of States from which to collect information. Table 2-3 shows the States with large numbers of plastic coating facilities. The EPA contacted State and local air pollution control agencies in these areas. The primary contribution from the State and local agencies was identification of plastic coating facilities (including names, locations, and coating process descriptions) and suggestions of facilities to visit.

TABLE 2-3. PRIORITY STATES FOR INFORMATION COLLECTION

California	Michigan
Florida	Minnesota
Illinois	New York
Indiana	Ohio
Massachusetts	Texas

Several State and local air pollution control agencies also provided operating permit (Title V) applications to facilitate site visits and the development of an industry-wide questionnaire. Further, seven State agencies performed database searches to provide EPA with the locations and contact information for additional plastic parts coating facilities, and in some cases, emissions information that was not obtained from the EPA's database searches.

By contacting these agencies EPA also obtained the most current applicable regulations and information on current control techniques. To date, 13 State and local agencies have enacted plastic coating regulations. Discussion of relevant State and local regulations is contained in section 3.0 of this document.

Site Visits. To date, five site visits were conducted to gather information for characterizing the industry and to observe current coating practices. The sites were selected because they represented differing production processes, coating operations, and emission sources. The EPA visited three heavy duty truck manufacturing facilities and two miscellaneous plastic parts coating facilities.

Choosing the heavy duty truck manufacturers was based on comments from the Truck Manufacturer's Association at the first stakeholder meeting. They stated that heavy duty trucks have coating processes and coating performance requirements unique to the industry. Therefore, EPA toured representative facilities to gain further insight about these issues. The site visits revealed several industry specific factors that may affect the feasibility of controls for this segment of the industry, including:

- Metal and plastic cab components are often coated on the same lines with the same coatings,

- A large number of customized colors are used, and

- The industry has stringent durability requirements for its coatings.

The EPA arranged site visits to two facilities that coat miscellaneous plastic parts to learn more about how the coating process can be flexible enough to accommodate many different types of parts. At the same time, EPA would learn more about the operations at smaller, contract coating facilities. Visits to these facilities demonstrated that there are unique, industry specific factors for this sector as well, because of the wide range of parts coated, varying specifications by the customer as to which coatings will be used, and the need for highly flexible process capabilities.

2.3 STAKEHOLDER PARTICIPATION

2.3.1 Stakeholder Members

The stakeholders for the plastic parts surface coating regulatory development represent not only plastic part coaters but also State and local air pollution control agencies, State small business ombudsmen, and coating formulators and manufacturers. The stakeholder participants are listed in the stakeholder meeting notes, which are included as appendix C.

Industry trade associations were invited to participate in the plastic parts coating stakeholder meetings. Each trade association was asked to notify their members of the opportunity to become involved as well. Participating trade associations are listed in Table 2-4.

In addition to the industry trade associations, EPA contacted State and Territorial Air Pollution Program Administrators (STAPPA) and Association of Local Air Pollution Control Officials (ALAPCO) and asked them to notify air quality program managers about participating. Further, since coatings are likely to be manufactured by businesses other than those applying the coatings, it was important to include coating formulators and manufacturers as stakeholders in the information gathering efforts. The National Paint and Coatings Association (NPCA) represents most coating manufacturers and has been an active participant.

TABLE 2-4. PARTICIPATING TRADE ASSOCIATIONS

Association	Acronym	Representing
Adhesive and Sealant Council	ASC	North American adhesive and sealant manufacturers and industry suppliers.
American Automobile Manufacturers Association	AAMA	Chrysler Corporation, Ford Motor Company, General Motors Corporation.
Association of International Automobile Manufacturers	AIAM	U.S. subsidiaries of the international automobile companies.
Chemical Manufacturers Association	CMA	Chemical manufacturing companies and raw material suppliers.
Electronic Industry Association/Consumer Electronics Manufacturers Association	EIA/CEMA	EIA represents U.S. electronics manufacturing companies, including small manufacturers of electronic parts, as well as multinational corporations that design and manufacture complex systems used by industry, defense, and consumers. CEMA is a sector trade association within EIA whose primary members are U.S. consumer electronic manufacturers.
National Paint and Coatings Association	NPCA	Paint and coatings manufacturers, raw materials suppliers, and distributors.
Society of Plastic Engineers	SPE	All areas of the plastics industry worldwide, including the manufacturer of medical plastics, automotive plastics, and composites, moldmakers, decorating and assembly, and recycling.
Society of the Plastic Industry	SPI	All segments of the plastics industry in the U.S.: plastic processors, raw material suppliers, machinery manufacturers, and moldmakers.
Truck Manufacturers Association	TMA	Manufacturers of medium- and heavy-duty trucks (weight classes 6 through 8) in the U.S.: Freightliner Corporation, General Motors Corporation, Mack Trucks, Inc., Navistar International Transportation Corporation, PACCAR, Inc., and Volvo GM Heavy Truck Corporation.

There is a large and diverse population of small and/or specialized coaters in this source category. These coaters are not necessarily represented by one particular trade organization, and therefore, efforts were made to include others in the regulatory development process. Contacts made through the Internet and State agency mailing lists have also been used to locate small businesses. Contact with small businesses will continue to be a priority in the next phase of regulatory development.

Overall the stakeholder group represents the plastics coaters, coatings manufacturers, and State and local regulatory agencies. Some participants represent their own businesses, while others represent trade associations or small business concerns.

2.3.2 Stakeholder Meetings

Three general stakeholder meetings were held during the initial phase of data collection (April 1997 to July 1998). The meeting summaries are presented in appendix C. The objectives of the initial meeting were to obtain stakeholder evaluation of EPA's preliminary data collection efforts and industry sector characterization, receive recommendations for filling in data gaps, and introduce EPA's options for industry-wide questionnaires. During the meeting, the major topics discussed were:

- The difficulty in characterizing the miscellaneous plastic parts sector;
- The need to coordinate development of the nine surface coating MACT standards, particularly where there is potential overlap in applicability;
- Title V permit applications as a source of relevant data;
- The importance of considering individual coatings as part of a coating system (as the lowest emitting primer, colorcoat, and clearcoat cannot necessarily be used together); and
- Difficulties in reporting accurate VOC and HAP contents in coatings. The Material Safety Data Sheets (MSDS) often list contents as a range of percentage by weight or volume, or list minor constituents as "less than" some de minimis value.

The second and third meetings were conducted jointly for the plastic parts and miscellaneous metal parts surface coating stakeholder groups. There was an interest by many participants in both projects because of several overlapping issues (including scope and definition of categories, plans for data collection, common application and control technologies, and overlap with other rules and programs). In addition to discussing overlapping matters, general data collection issues and concerns about subcategorization were also brought forward. Additional topics included the following:

- Establishing a MACT floor and types of information utilized;
- Inclusion of adhesives as coatings in the regulatory development process;
- Consideration of the use of low volumes of specialty coatings with high VOC and/or HAP content;
- The need for data collection via a coatings system approach (considering all coatings applied to a particular part as a "system," thereby, addressing coating compatibility issues);
- Development of an industry-wide questionnaire, the types of information to be collected, and the need to facilitate cooperation between all surface coating MACT source categories; and
- The possible development of a coating suppliers questionnaire to provide additional, coating specific information not fully captured in the coating users questionnaire.

2.3.3 Stakeholder Subgroups

Two stakeholder subgroups were formed: a regulatory stakeholder subgroup and a small business stakeholder subgroup. These subgroups were convened to better address their specific issues.

The small business subgroup was comprised of individuals who represented small businesses. Some of the members of this group represented Federal and State government small business advocacy agencies, while other members of this group represented small businesses in the industry. The EPA's goal was to have this group provide insights from a small business perspective as EPA moves into rule development.

The EPA conducted two conference calls, one with each subgroup. The meeting minutes from these conference calls are included as appendix D. Lists of the participants in each subgroup are included in the meeting notes.

3.0 DESCRIPTION OF THE SURFACE COATING OF PLASTIC PARTS SOURCE CATEGORY

Surface coating of different types of plastic parts and products occurs as part of a wide variety of manufacturing processes. The parts that are coated range in size from small plastic logo labels on business machines to roofs and panels for heavy duty trucks. Products range from automotive body parts to laboratory equipment, food service equipment, toys, sporting goods, building trim materials, and computers. Most plastic products currently manufactured have molded-in color and therefore have little or no need for coatings to be applied. Products that receive surface coating are those that require protection from the environment in which they are used, or for which consumers expect a certain finished appearance. In addition, operations such as the application of adhesives, sealants, and caulks to plastic parts is considered a surface coating operation. The major plastics manufacturing industry sectors that apply surface coatings are:

- Heavy duty truck parts,
- Automobile and light duty truck parts,
- Business machine parts, and
- Miscellaneous parts.

The SIC Codes for industries included in this source category are discussed in section 2.2.2 and are shown in Table 2-1. There are at least a dozen four-digit SIC Codes that include surface coating operations for plastics, but each of theses SIC Codes includes operations and activities outside the scope of this source category as well.

3.1 INDUSTRY PROFILE

3.1.1 Overview of the Plastic Parts Coating Industry

Plastic products are manufactured in almost every conceivable size and shape with a variety of properties to facilitate an assortment of end uses. The coating and decorating of plastic parts is a high priority in the plastics industry because competition to sell such varied products is quite high.[2] Selection of a decorating technique can often determine the success of a product and can significantly affect its final market price, as finishing operations can amount to a large portion of the total production cost. Consumer products such as automobiles, appliances, furniture, building products, containers, and packaging usually depend on attractive decorating and appearance for "point-of-purchase" sales.[3]

Plastic parts may be coated to provide color, texture, or protection, thus improving appearance and durability. Coatings also function to attenuate electromagnetic interference/radio frequency interference (EMI/RFI) signals and to conceal mold lines and flaws in the substrate surface of molded plastics. Adhesives are also used for affixing predecorated materials to plastic surfaces, and adhesive bonding of pieces is widely performed in plastics assembly processes. Such coating and assembly of parts in the plastics industry are often referred to as "secondary operations." These secondary operations are carried out not only by fabricators of plastic parts, but also in product assembly facilities and contract coating facilities. Thus, the use of decorating technology is widespread throughout the plastics industry, more so than the fabrication of plastic parts by molding or other techniques.[2]

Applying a color coat is probably the most common way of decorating plastic parts for several aesthetic, commercial, and functional reasons (for example, reflective properties). Often the commercial failure of a plastic product can be traced to the failure of the manufacturer to satisfy the color demands of the consumer. In today's market, color can make the difference between selling and not selling a product.[2] But whether to mold-in the color or to paint a nonpigmented plastic product, or both, is a decision that needs to be made for each individual case and is governed by cost, appearance quality, and product performance properties.

Plastic parts surface coating facilities may fall into three general categories: (1) an "in-house" process located at the end-product manufacturing site, (2) a contractor shop that specializes in plastic parts molding and coating, or (3) a contract coating facility that performs only painting ("toll coaters"). The complete in-house processes are common in the automotive and truck manufacturing industries, and some business machine manufacturing sites. Such companies will manufacture their proprietary products in-house beginning with fabrication of the plastic pieces through finishing and assembly. Companies known as contract facilities perform plastic parts design, molding, coating, and assembly all under one roof, but the work is contracted by other businesses who ultimately put the end product on the market. Both types of facilities may have conveyor finishing lines which directly transport the plastic parts through spray painting and drying lines to the decorating and assembly areas.

Both end-product plastics manufacturing facilities and contract facilities may also ship their plastics off-site to be finished by contract coating facilities that perform only secondary operations. Toll coaters (contract coating facilities) may paint various types of substrates, including plastics and metals, and can often handle both high and low volumes, some through the use of robotic lines. The use of robots to apply coatings yields benefits which include precise part-to-part repeatability and cost-effective high volume production and flexibility.[3] Many of these coaters serve the miscellaneous plastic parts coating sector as well. By specializing in finishing operations (coating and/or decorating), many are able to offer a wide variety of finishes, plating techniques, and coating processes. As such, they become specialists in applying protective and decorative coatings and can keep up with the latest technologies, which may not be affordable in-house at plastics manufacturing sites. Such coaters can often operate a full range of machinery and can then accommodate all types of products. Because these facilities do not manufacture the plastics, the parts will be coated according to the plastics manufacturers' specifications, packaged to provide protection during transport, and returned usually with quick turn around times. Plastic parts manufacturers consequently may find it more economical and efficient to send their parts off-site to be coated.

Regardless of who actually performs the coating and assembly, the characteristics of the paint or finish (i.e., color, gloss, adhesion, and chemical resistance) and the affixing of labels or decorations are usually specified by the plastic part's end user. In some cases the end user may be a manufacturing plant (for example, of automobiles, heavy duty trucks, business machines, or appliances) that will be assembling the coated plastic parts to make a larger finished product, or the end user may be the consumer, as will be the case for many miscellaneous plastic parts, such as flower pots, shower heads, or costume jewelry.

3.1.2 Industry Sector Descriptions

The plastic parts surface coating industry is diverse and complex. For purposes of data collection, EPA has divided the industry into four general sectors: (1) heavy duty truck parts, (2) automobile and light duty trucks parts, (3) business machine parts, and (4) miscellaneous parts.

Heavy Duty Truck Parts. The heavy duty truck parts sector includes coating of both interior and exterior components and accessories, such as grilles, chassis parts, and headlamps, that are coated in-house within the truck assembly process line. Topcoats are applied to plastic parts at the assembly plant, while some parts are primed off-site. Appearance and substrate protection are often the major reasons for coating plastic parts in the heavy duty trucks manufacturing sector.

There are 15 heavy duty truck assembly plants located in 11 States, in addition to numerous parts plants. Virtually all heavy duty trucks are custom designed and each truck manufacturer draws from only one coating supplier. Over the past several years, most heavy duty truck coatings have been reformulated to a higher solids content in an effort by the industry as a whole to lower VOC emissions. Apparently, few waterborne coatings are currently used in this sector. Coating performance requirements for heavy duty trucks include a one million mile warranty.[4] Other coating issues identified for this industry include:

- Use of customer specified colors and a large color selection (an average of 600-900 colors are used per year in a typical plant),
- Large surface areas with variable sizes and shapes,
- Exposure to extreme environmental conditions,
- Use of multiple substrates and primers,
- Batch-type operations and mixing machines,
- Low-bake requirements for touch-ups; and
- Military and government coating specifications.

As plastic components may be attached to the chassis or to other truck parts at several points during the assembly process, plastic and metal surfaces will often be coated simultaneously, with the same paint system.[2,4] Both the curing temperature and the stiffness of the substrates differ for metal and plastic. Coatings designed for plastics are normally quite flexible, whereas paints for metal parts are often too inflexible for plastics. One solution is to utilize a "uni-coat paint system" designed for products assembled from both metal and plastics that optimizes the performance on both types of parts and allows the paint film to dry at low enough temperatures to avoid thermal issues with the plastics.[2] The use of one system that can be applied simultaneously to metal and plastic surfaces avoids subtle color mismatches that can occur if plastic and metal parts are painted separately.

Automobile and Light Duty Truck Parts. The automobile and light duty truck parts sector includes coating accessories and components (both interior and exterior) for cars, trucks, vans, and sport utility vehicles. This industry is an important consumer of molded plastics, many of which are painted or metallized (for example, chrome-plated) such as grilles, headlamp bezels, and wheel covers.

This sector differs from the heavy duty truck parts sector in that it does not include those plastic parts which are coated in the automobile assembly process line because parts coated on the assembly line are covered under the Automobile and Light Duty Truck NESHAP. However, in this sector of plastic parts surface coating, plastic parts are often painted off-line or off-site by a contractor who may or may not also mold the parts.

The EPA has identified 54 facilities in 11 States that coat plastic parts associated with the automobile and light duty truck industry. Typically, over twenty different plastics types are used in automobiles, each of which requires development and control of specific paint systems tailored for that particular substrate and application.[3] In addition, the raw materials used in the manufacture of automotive components is a highly technical and quickly changing industry in itself. Thus, the coatings for plastic automotive components must vary to match. Further, each model year brings additional automotive components that are formed from plastic compounds. Plastic is replacing metal, or in the case of lighting assemblies, glass, to meet the demand for weight and cost reduction, greater durability, and recyclability. The plastic components require functional and decorative coatings that meet the same demands as the metal or glass parts that they replace.[3,5]

Business Machine Parts

The business machine parts sector includes coating of plastic housings for electronic office equipment such as computers, photocopy machines, typewriters, word processors, telephones, and medical equipment. The plastic components in this industry sector are coated for three major reasons: (1) to improve their appearance, (2) to protect the plastic part from physical and chemical stress, and (3) to attenuate EMI/RFI signals that would otherwise pass through the plastic housing.[1] The coating of plastic components for the business environment is primarily driven by appearance and functionality. For example, structural foam is widely used for electronic equipment housing and similar applications. The surface of such rigid plastic foams often exhibits swirl and other imperfections which requires extensive finishing, including priming and painting.[5] Some of the business machines manufactured are used in outdoor or laboratory conditions. These machines must be able to withstand the physical and chemical stresses of their operating environment. Additionally, business machine components require EMI/RFI coatings critical to their proper functioning. EMI/RFI signals emitted from enclosed electronic components can pass through plastic housings. These signals, when emitted from business machines, may interfere with the performance of other electronic devices such as radios and televisions. Conversely, EMI/RFI signals from outside sources can also hinder the proper functioning of electronic components in an unshielded plastic business machine. To combat EMI/RFI propagation, the FCC has placed restrictions on the maximum EMI/RFI emissions from computing devices. Coatings are frequently used to comply with these restrictions. Copper, nickel, silver, or other metallic-impregnated paints are applied to plastic surfaces that require such shielding. Application of an additional, conformal coating (an insulative barrier) must often be applied over the EMI/RFI shielding.[6]

The EPA has identified 50 facilities in 22 States that coat plastic parts associated with the business machine industry. There are also companies that specialize in the refinishing of plastics (for example, the plastic covers of certain types of office equipment and business machines). Additionally, metal and plastic pieces will frequently be coated together, especially when larger machines, such as photocopiers, are recoated.[7] Recoating the external panels of office equipment can restore their original appearance or change their color and reduces the amount of plastics sent to landfills.

Miscellaneous Parts. The miscellaneous part sector covers numerous products in a variety of industries. Miscellaneous plastic parts may be found in appliance products (for example, clothes washer and dryer components, hair dryer components, stereo sets, television and radio housings), plumbing and marine products (for example, shower heads, faucet handles, housings for boat lighting fixtures), household products (for example, flower pots, frames for pictures and mirrors, lighting fixture bases), and other consumer products (for example, cosmetic cases, trophies, toy components, costume jewelry, sporting goods, optical lenses for safety glasses and goggles). While many miscellaneous plastic parts are made from plastics with molded-in color, surface coatings are applied to a wide variety of these parts.

The EPA has identified 396 facilities in 33 States that coat plastic parts associated with the miscellaneous plastic parts industry. The coating selections and requirements for the miscellaneous sector depend on the end use specifications. However, as discussed previously, appearance and protection will tend to be important considerations. Some of the major reasons for coating might include the need for highlighting, texturing, protection, appearance uniformity, hiding defects, functionality, or creating a second surface (unique to transparent plastic parts).[8] In some cases, metal and plastic parts are assembled and coated simultaneously.

Toll coaters comprise a large portion of the miscellaneous plastic parts coating sector. These companies often specialize in the coating, decorating, and assembling (including the application of adhesives, sealants, and caulks) of various parts with differing sizes and shapes. Thus, they are an obvious choice for manufacturers of miscellaneous plastics who require these secondary operations.

3.2 COATING PROCESS DESCRIPTION

This section of the document describes the operations typically conducted at facilities coating plastic parts. The primary basis for this description is the site visits discussed in section 2.2.2 and the plastic parts ACT document.[1] Considerable variability exists among the plastic parts surface coating facilities, so the focus of this section is not on a typical coating line operation but rather on the individual processes that can comprise a coating line. At any given facility, the number and sequence of operations will be a function of the plastic substrate being coated and of the given coating. But some general principles are common to all plastic parts surface coatings, and these are discussed below.

Section 3.2.1 describes the processes typically found on a coating line. Section 3.2.2 mentions some of the differences found at a smaller contract coating facility. Section 3.2.3 details common application techniques for coating and Section 3.2.4 provides some general information about ancillary processes (including adhesives application).

3.2.1 Typical Surface Coating Processes

Because of the wide variety of plastic parts and coatings, no generic coating line description can adequately convey the range of operations at surface coating facilities. Coating lines vary not only in composition (for example, different numbers of coating stages and drying ovens) but also in degree of automation. Some coating lines are incorporated together such that plastic parts are conveyed through the coating sequences mechanically, while other coating lines consist entirely of manual operations. This section of the document will therefore discuss the common stages typically encountered in a coating line rather than describing a specific configuration that is typical to the industry.

Surface Preparation. Surface preparation is performed for two main reasons, to correct any flaws in the part prior to coating and to prepare the part to receive the coating. Some sanding may be performed to remove burrs or other surface inconsistencies. Puttying may be necessary to fill in any gaps or small cracks in the plastic part. For pre-primed plastic parts, spot primer may be applied to any areas missing primer or with an inconsistent primer application. Following this type of pretreatment, any remaining surface residue must be removed, typically by wiping off the dust with water or solvent-soaked rags. Acetone or a hot water and grit material solution can also be used as an alternative to HAP or VOC-laden solvents to remove any tape adhesion, dirt, or dust.

Varying degrees of cleaning are possible, including multiple washing cycles with proprietary soaps or solvents or deionized water. Also, depending on the types of coating to be applied, surface preparation can include treatment of the part to provide for better coating adhesion. For example, applying a conductive coating is necessary for plastic parts to be coated by some electrostatic coating application techniques.

Spray Booths. Coatings are typically applied in partially or totally enclosed spray booths. (Spray application techniques are further discussed in section 3.2.3.) The degree of automation of the coating line is usually a function of the size of the facility and the range of types of plastic parts coated. Automated spray booth systems are more likely to be used in larger facilities or for parts with flat or uniform surfaces. Parts may be manually wheeled to the spray booths on drying racks and placed into and out of the booth by hand, or the parts may be automatically conveyed to the booths via racks or paint hooks.

Regardless of how the parts are introduced into the spray booth, the booths have some common characteristics. A positive or negative pressure exhaust system is used to ensure airflow though a filtering mechanism. Some typical configurations include down draft airflow through a water curtain that runs below a grilled floor, and cross draft airflow through dry filters on the rear wall of the booth. The exhaust system reduces the airborne solvent concentrations to safe levels inside the booths and these filtering mechanisms control overspray. Overspray is the coating solids that either miss or bounce off the part (see discussion of transfer efficiency in section 3.2.3).

Partially open booths are subject to the ambient environmental conditions at the facility, but fully enclosed booths are typically monitored to ensure a desired exhaust airflow, temperature, and humidity (all of which contribute to the quality of the finished part's coating). A coating line can consist of a combination of booth types, and a single part may be coated multiple times in the same booth to apply different coatings with different properties (such as color).

Tape, paper, or other type of shield can be used to mask certain portions of the plastic part so that the color is applied only to the proper area. The part is coated in one color, masked, and then coated in a different color. When the masking is removed, the part will have the multiple colors in the designated areas.

When a coating is changed in a paint booth, the spray equipment must be cleaned prior to introduction of the new coating. This is usually accomplished by running an amount of cleaning solvent through the spray equipment in the booth. The degree of cleaning necessary and the types of solvents used are both functions of the previous coating and the next coating. The booth itself is cleaned regularly (once a week is typical) with solvent or water-based cleaning solutions.

Operators clean some booths by spraying a special coating onto the interior surface of the booth itself. This coating easily peels off, capturing any dust or overspray that was previously on the booth's walls.

Captured overspray must be disposed. In a wet booth, where overspray is controlled through a water curtain, the water must be treated to remove the suspended coating solids. In dry booths, the filters are routinely replaced. Spent filters are typically disposed of as hazardous waste.

Flash-off Zones. Immediately following coating application, plastic parts are introduced into a flash-off zone. This zone can be a designated area on an automated coating line between the spray booth and curing oven, or the zone can simply be the drying rack in a manual line where the parts are placed prior to entering a curing oven. The purpose of the flash off area is to allow partial curing as solvent evaporates from the coated part.

Curing Ovens. Conventional coatings for plastics are generally classified as high-bake or low-bake. High-bake coatings require elevated temperatures to fully cure. Typical temperature and residence time for high-bake coatings is 20 minutes at up to 300 ^{o}F, whereas typical temperature and residence time for low-bake coatings is 20 to 30 minutes at up to 130 ^{o}F. Many plastic part coatings will cure satisfactorily at ambient conditions, but plastic parts are often introduced to elevated temperature to speed the curing time.

The desired curing conditions, including temperature, residence time, and humidity, are highly dependent on the type of coating used and the properties of the substrate being coated. For example, a coating that requires a bake temperature of 300 ^{o}F cannot be used on plastic that deforms or distorts at that temperature. Therefore, substrates such as acrylonitrile butadiene styrene resins and epoxies that are not heat tolerant require coatings that cure at low temperatures. Such coatings tend to have higher VOC or HAP content to promote adequate curing speed.

Other coatings, such as ultraviolet (UV) curable coatings, will require special curing stages. For example, a UV curable coating cures under UV lamps.

3.2.2 Contract Coaters

Many smaller, contract coating facilities coat a variety of miscellaneous plastic parts. These facilities apply coatings that are supplied or otherwise specified by their clients. Their operations must therefore be flexible enough to incorporate a wide range of coatings and application technologies, and substrate types.

Because of the variability inherent to such operations, dedicated coating lines are not typically found in the industry. Instead, several coating booths may be stationed throughout the facility, and parts can be manually moved on racks from manufacturing areas to surface preparation to coating. Parts can then flash-off and cure at room temperature or in drying ovens that are not necessarily dedicated to spray booths in a conventional coating line structure. The operations that are performed are a function of the plastic part being coated and the coating being applied, and therefore not every part will go through every process. For these facilities, operational flexibility is a key component to their business.

3.2.3 Application Technologies

The majority of coating applications is achieved through spray technologies. Adhesives, sealants, and caulks, however, may be hand-applied through a variety of methods. This section focuses on spray application techniques.

As briefly discussed in section 3.2.1 (spray booths), overspray is the amount of coating solids that either miss or bounce off the part being coated. Transfer efficiency is defined as the ratio of solids adhering to solids sprayed. Numerous factors affect how well a coating is transferred to a part, including the type of spray equipment, the part shape, the spray booth characteristics and the operator's skill. The various spray techniques used to coat plastic parts differ in the manner in which they break up, or atomize, the coating. Some methods have better transfer efficiencies for a specific substrate and a given coating. Common methods include:

- Conventional Air Spray. Conventional air spray is the traditional method of applying coatings. Compressed air is supplied through an air hose to a spray gun, which atomizes the coating into a fine spray. The pressure supplied to the fluid controls the coating delivery rate, with typical pressures ranging from 5 to 25 pounds per square inch (psi). The air pressure controls the degree of atomization, and is usually 30 to 90 psi. One of the major problems with conventional air spray is the overspray caused by the high volume of air required to achieve atomization. This overspray typically results in a relatively poor transfer efficiency.

- Airless Spray. With airless spray, a pump forces the coating through an atomizing nozzle at high pressure (1,000 to 6,000 psi). Airless spray is ideal for rapid coverage of large areas and when a heavy film build is required. The size of airless spray paint droplets is larger, the spray cloud is less turbulent, and the transfer efficiency is typically superior to conventional air spray. However, airless spray leaves a rougher, more textured surface; therefore, it is generally used on surfaces where appearance is not critical.

- Air-Assisted Airless Spray. An air-assisted airless system combines the benefits of conventional air spray and airless spray. The system consists of an airless spray gun with a compressed air jet at the gun tip to atomize the coating. It uses lower fluid pressures than airless spray and lower air pressures than conventional air spray (5 to 20 psi versus 30 to 90 psi). This combination of fluid pressure and air pressure delivers a less turbulent spray than conventional air systems and applies a more uniform finish than airless systems. However, the amount of time needed to apply coatings is greater because of the lower air pressure.

- High-Volume/Low-Pressure (HVLP) Spray. A modification of conventional air spray is HVLP spray, which uses large volumes of air under reduced pressure (10 or less psi) to atomize coatings. Because of the lower air pressure, the atomized spray is released from the gun at a lower velocity. Overspray is reportedly reduced 25 to 50 percent over conventional air spray. The air source for the HVLP can be a turbine or a standard air supply, both of which can handle multiple spray guns. Manufacturers have constructed the fluid passages out of stainless steel or plastic so that these guns are compatible with a full range of paints, solvents, and water based materials. Many HVLP spray systems are designed to atomize high-, medium-, or low-solids coatings.

- Electrostatic Spray. In electrostatic spray application, the coating and part are oppositely charged. The part is grounded and attracts the negatively charged coating. Electrostatic spray systems are reported to have the highest transfer efficiency of any of the spray application techniques because of minimal overspray, which also results in lower paint loss and lower VOC emissions. One limitation of the electrostatic spray technique is that the part to be coated must be conductive. Plastic parts not made of a conductive substrate are often made conductive by applying compatible polar solutions to the surfaces and/or placing the parts on a metal backing.

- Zinc-Arc Spray. Metallic zinc may be applied to plastic to provide a conductive surface or shielding. This two-step process first roughens the plastic surface (usually the interior of a housing) by grit-blasting or sanding, and then spray-coats with molten zinc, either manually or with robotics. The zinc-arc spray gun operates by mechanically feeding two zinc wires into the tip of the spray gun where they are melted by an electric arc. A high-pressure air nozzle blows the molten zinc particles onto the surface of the plastic part.

3.2.4 Ancillary Operations

Plastic parts coating facilities generally include additional operations that have the potential to introduce VOC or HAP into the atmosphere. In particular, equipment cleaning and adhesives application have been included in the data gathering tasks. In addition, many facilities (especially those with automated coating lines) will have an inspection or finishing area where touch-up coatings are applied to complete the final product. These activities will be assessed as part of the plastic parts surface coating source category because they are potential sources of VOC and HAP emissions at the facilities coating plastic parts.

Equipment Cleaning. As previously discussed in section 3.2.1 (spray booths), when a change in coating is made the spray equipment--and perhaps the booth itself--must be cleaned. Cleaning solvents are typically used to spray through the application equipment or wipe down the interior of the spray booth. Acetone, toluene, or xylene can be used to clean spray guns and purge the coating lines of solvent-based coatings. Water-based coatings can be cleaned from the equipment with water. The interior of the spray booths can be cleaned with solvent, water, or a water-based peel-off cleaner that is sprayed on the interior walls directly.

Cleaning solvents may be used in the touch-up areas to either prepare a part for a touch-up coating or to clean a part prior to final product delivery. For example, MEK can be wiped by hand across the plastic part to make it appear clean and shiny prior to shipment.

Spent cleaning solvents are collected along with coating waste. These materials are typically treated or disposed off-site although some facilities collect spent solvents and recycle and reuse them on-site.

Adhesives Application. Some facilities manufacture and assemble the plastic parts that they coat, and this often involves glueing two pieces of plastic together. While some advanced adhesive-free technologies, such as ultrasound welding, are applicable to certain limited applications, most adhesion is accomplished through application of a solvent or combination of solvents. Typical adhesives include tetrahydrofuran, methylene chloride, and methylphthalate-based two-part epoxies.

The solvent breaks down the plastic molecules on the surfaces to be joined, and the fused part, following adhesion, has strong bond characteristics. Because of the interaction between the solvent adhesive and the plastic substrates, not all adhesives will perform with all substrates. Substrate properties and desired bond strength dictate which adhesives can be used.

Solvents used for adhesion are often stored in air-tight canisters and are applied to the plastic through syringes or other methods that minimize the possibility of VOC or HAP emissions by minimizing the amount of solvent used and the exposure time of the solvent to the air. Some volatilization will occur as the adhesive cures.

Touch-up. Coatings are often applied in a touch-up area to repair slight imperfections or to fill in areas that were not completely coated during the process. These coatings can be spray-applied in a booth, but they are often applied via other means such as brush application or aerosol cans. The coatings in the touch-up area, because they do not receive the same degree of carefully controlled curing times and temperatures as the main coating, have different characteristics. Touch-up coatings are typically solventborne and have higher VOC content than the standard coatings in use at a facility.

3.3 EMISSIONS CHARACTERIZATION AND CONTROL

The primary sources of information used to characterize emissions and controls are the plastic parts ACT document and site visits conducted by EPA.[1] To update this information, emissions characterization and control options will be a major focus of future data gathering efforts. Section 3.3.1 describes the sources and composition of VOC and HAP emissions from plastic parts surface coating. Section 3.3.2 details various control technologies.

3.3.1 Emissions Characterization

Emissions of VOC and HAP at surface coating facilities primarily occur at the surface coating operation itself. Most VOC and HAP emissions occur at the spray booth, in the flash-off zone, or in the drying ovens, while some potentially significant emissions may occur at ancillary operations such as surface preparation, plastic part adhesives application, equipment clean-up, coating storage and mixing, or plastic parts touch-up.

Emission Points. Emission points occur at all three main areas of the coating line (spray booths, flash-off zones, and curing ovens) discussed in section 3.2 of this document. The percent of total emissions attributed to each is a function of several factors, including the transfer efficiency in the spray booth, the length of time spent in flash-off, the use of curing ovens, and the characteristics of the substrate and coating. Where emissions are occurring and how much are attributable to each area may limit the control options. For example, the spray booths and drying ovens may be enclosed and routed to a control device while a flash-off zone is typically open to the facility interior (and therefore indirectly emitted to the atmosphere).

Transfer efficiency has a significant affect on the distribution of emissions. Only the coating that actually impacts and adheres to the plastic part will leave the booth with the part and will have an opportunity to dry (i.e., the solvent evaporates) outside of the spray booth. For example, if the transfer efficiency is 30 percent, then at least 70 percent of the overall emissions occur at the spray booth. Additional emissions from drying are presumed to occur in the spray booth after the part is coated, but before the part can be removed from the booth to a flash-off zone or to a drying oven. For example, if several similar parts are being coated in a spray booth at the same time, the first parts coated will begin to dry as the rest of the parts are coated. The majority of these emissions from the booth depend in part on the amount of time the parts remain in the booth.

Emissions from the flash-off zone are a function of the amount of time spent in the zone, the humidity in the zone, and the characteristics of the substrate-coating combination. Some coatings applied to plastic substrates have a low drying temperature (i.e., they contain solvents with a low boiling point). Significant drying of these coatings can occur in the flash-off zone, resulting in greater emissions during flash-off and a relatively small portion of the total emissions from the subsequent drying oven. Emissions from flash-off zones are not typically controlled, and they may account for a significant portion of the HAP and VOC emitted during the coating process.

Drying ovens, if present, produce additional emissions in a closed system as the coating continues to dry. But, as previously discussed, much of the solvent present in the coating may have already evaporated prior to the drying oven. A high-bake coating, however, may not significantly dry in the flash-off zone, so emissions in the drying oven are expected to be greater than in the flash-off zone.

The properties of the coating itself, especially the curing time and temperature required, influence where in the process the emissions result. Quicker cure times, for example, can cause greater emissions in the spray booth and flash-off zones before the coated part is transferred to the curing oven.

Some additional emissions are also possible as chemical reactions continue in the coating for some time, perhaps even beyond the drying oven. These emissions are referred to as "cure volatiles" because the chemicals emitted may not be present in the coating or the substrate prior to curing of the coating. Most of the total emissions, however, can be assigned to the spray booth, flash-off zone, or curing oven.

The configuration of these operations can influence the emissions as well. For example, a facility where plastic parts are manually moved from a rack into a partially enclosed spray booth under a vented hood will have different emission characteristics than an automated facility with a totally enclosed spray booth. Plastic parts coated one by one in a partially enclosed booth will produce emissions during flash-off from the drying rack after they are coated and as the rest of the parts are coated. These emissions will occur outside the booth. In a fully enclosed booth, flash-off will occur mainly in the spray booth as the rest of the parts are coated.

Work practices can also affect the amount and distribution of HAP and VOC emissions. Coating supplied to the spray booth can be accomplished by fully enclosed piping from the mix room to the booth or by hand-carried buckets. Mixing can be performed manually or automatically in different methods that expose the coating to the atmosphere for different times. In addition, the quantity of coating mixed can affect emissions (for example, 5 gallon buckets have a larger surface area for evaporation than pint-sized containers). In general, manual, open work practices provide a greater opportunity for HAP and VOC emissions than enclosed or automated work practices.

Additional emission points may be associated with surface preparation, adhesives application, part cleaning, and touch-up. The potential for emissions also exists where the coatings are stored and during mixing and transfer to the spray booths. Also, some air emissions may result from solvent distillation if a facility reclaims its own cleaning solvent on-site.

HAP and VOC Emitted. The compounds emitted from plastic part surface coating are the volatile components of the coatings. The EPA assumes that 100 percent of the solvent in the coating, including any solvents or thinners added to the coating at the facility, is emitted. Therefore, a mass balance of VOC and volatile HAP can be used to estimate emissions if coating VOC and HAP content and coating usage data are known. The mass balance should also attempt to estimate the type and quantity of cure volatile emissions because the cure volatile species formed and emitted may not be present in the coatings (i.e., the "inputs" to the mass balance) prior to curing.

Estimates of total VOC emissions are usually obtainable as the coaters have data on the solids content, water content, and solvent content of the coatings applied. Coupled with data identifying the quantity of the coatings applied, a mass balance for total VOC can be calculated. Individual VOC and HAP species emitted, as well as total HAP emissions, are less easily obtained, as the precise coating content information is typically proprietary. MSDS are required to list only those VOC and HAP species that comprise greater than 1.0 percent by weight (0.1 percent by weight for carcinogens). All contents can be reported on an MSDS as a range or maximum volume percentage of the components. Even full-disclosure MSDS, which may present every component of the coating, typically report ranges for the percentages.

Some HAP species have been identified as common components of coatings used for plastic parts, including the following:

- Ethyl benzene,
- Ethylene glycol,
- Formaldehyde,
- Glycol ethers,
- Methanol,
- Methyl ethyl ketone,
- Methyl isobutyl ketone,

- Toluene, and
- Xylene.

All of these HAP are also VOC. Some coating components may be HAP compounds but are not VOC. One such compound is nickel, which is used for EMI/RFI shielding. Furthermore, it is likely that many VOC components in coatings are not listed HAP.

3.3.2 Control Technologies

Several different control strategies are applicable to the plastic parts surface coating industry. In general, control technologies consist of either pollution prevention practices, process modifications, or add-on control equipment. This section briefly describes the types of controls EPA encountered during site visits. In addition, it includes a summary of the plastic parts ACT discussion of control techniques.[1]

Control Technologies from the Site Visits. The most common control technique EPA encountered during the initial site visits was HVLP spray equipment used inside a fully or partially enclosed spray booth, with the booth exhaust routed through a water wash system or dry filter. As discussed in section 3.2.3, HVLP equipment can reduce overspray, lowering coating consumption as well as emissions.

Fully enclosed spray booths can be vented through a water wash or dry filters, with the primary function being control of particulate matter emissions. Wastewater from a water wash must be treated either on- or off-site. On-site treatment may include separation and removal of the captured coating solids. Dry filters and recovered coating solids are generally discarded as hazardous waste following use.

Many facilities and suppliers have attempted to find suitable low VOC content coatings, especially over the previous 5 to 10 years. While some have been adopted, the nature of some plastic substrates, combined with desired finish characteristics, currently appear to require high VOC content coatings.

Another common approach that State agencies use to limit emissions is through permitting a facility to operate with some degree of averaging. A facility can operate under a facility-wide average VOC content limit (for example, a facility-wide 3.5 pounds/gallon VOC coating content limit, based on a monthly average). Such a limit is flexible enough to permit small amounts of high VOC content coatings to be used so long as most of the coatings have a low VOC content.

<u>Control Technologies Discussed in the ACT Document</u>. The plastic parts surface coating ACT provides detailed information (current in 1994) regarding several control technologies, including many pollution prevention measures.[1] Waterborne and high solids content coatings are discussed as are two low VOC content coatings. In addition, the ACT details non-emitting technologies including UV curing, powder coatings, and vapor cure coatings. The ACT explains each of these pollution prevention measures, provides the merits of each, and discusses the suitability of each to surface coating of plastics parts.

The ACT contains information on process modifications such as switching the spray equipment to HVLP spray guns. Much of this information is presented in terms of potential environmental benefit, but EPA recognizes that many facilities may have already modified their processes to take advantage of HVLP technology.

In addition, the ACT provides detailed discussions of the following control devices: incinerators, carbon adsorbers, incinerators coupled with carbon adsorbers, absorbers (i.e., scrubbers), and condensers. The ACT provides the suitability, typical control efficiencies, and other characteristics of each control device.

3.4 SOURCE CATEGORY SCOPE AND OVERLAP

The EPA identified several issues relating to the scope of and overlap with the plastic parts surface coating source category. Section 3.4.1 discusses the scope of the plastic parts surface coating source category. Section 3.4.2 addresses overlap among the surface coating source categories for which rules are currently under development. Section 3.4.3 summarizes existing Federal and State regulations that have the potential to overlap with the plastic parts surface coating source category.

3.4.1 <u>Scope</u>

For purposes of regulatory development, the scope of the plastic parts surface coating source category will include not only the processes that apply coatings (i.e., traditional coatings, adhesives, sealants, and caulks) to plastic parts but also the ancillary operations necessary to the coating application. These ancillary operations include surface preparation, coating storage and mixing, and equipment clean-up.

Including particular processes in data gathering activities does not necessarily imply that a MACT floor or standards will be set for all of those processes. The EPA collects information regarding these processes, particularly regarding HAP and VOC emissions, and then assesses the findings to determine if they are significant emission sources and their potential for control. Information collection could reveal that certain parts of a process do not, in fact, contribute significantly to HAP or VOC emissions. In such a case, EPA could decide not to set standards for that particular part of the process. Data collection on the surface coating of plastic parts source category is still ongoing. At this time, a decision has not been made as to which emission sources will be covered by standards.

In addition, statutory language regarding the regulated entity affects the definition of the scope of the source category. For MACT standards under section 112 of the Act, the regulated entity is the source of emissions of the HAPs listed in section 112(b) of the Act; for plastic parts coating, this is the facility where coating application takes place. Section 183(e) of the Act states that the regulated entity for federal VOC rules is the manufacturer, processor, wholesale distributor, or importer of the consumer or commercial product listed for regulation. For plastic parts coating, this would be the coating manufacturer. On the other hand, if EPA makes a determination under section 183(e)(3)(C) of the Act to regulate plastic parts coatings with a CTG, then the regulated entity for Reasonably Available Control Technology (RACT) is the user of the product (i.e., the coater). The EPA has not yet made a determination that a CTG would be significantly as affective as a federal VOC rule.

3.4.2 Overlap with Other Source Categories

The list of source categories to be regulated with MACT standards under section 112 of the Act and the list of consumer and commercial products to be regulated under section 183(e) of the Act both include several industrial surface coating operations. Some of these categories are related or similar to plastic parts coating, and there is a certain potential for overlapping applicability among the planned standards for these industries. In particular, the miscellaneous metal parts, boat manufacturing, reinforced plastic composites manufacturing, automobile and light duty truck assembly, large appliances, metal furniture, and miscellaneous industrial adhesives source categories have potential overlap with the plastic parts source category. Table 3-1 lists these source categories, the rules under development for them, and the EPA's current recommendations regarding their potential applicability. These rules include:

- Miscellaneous Metal Parts. The miscellaneous metal parts surface coating source category includes coating of metal parts and products. In some industrial operations such as surface coating of heavy duty truck cabs, metal and plastic parts are often assembled and then coated simultaneously with the same coating. As another example, the plastic and metal parts can receive different prime coats, each of which prepares the respective substrate for the identical color coat. In order to avoid having a single coating or coating application subject to two different MACT or VOC standards, regulatory development for the two source categories are being coordinated. Potential solutions might include: (1) coordinate the two projects and develop a single MACT floor applicable to both substrates, or (2) include coatings applied to metal and to plastic within the scope of only one of the source categories. The regulatory development process for miscellaneous metal parts and for plastic parts has been closely coordinated since the outset. Joint site visits and stakeholder meetings have taken place, and data on coating contents and coating processes have been shared where plastic and metal substrates are both involved. For the next phase of data collection (the MACT survey), the miscellaneous metal parts project will be collecting data on surface coating operations where metal and plastic are coated simultaneously.

- Boat Manufacturing. Coating operations are performed at some fiberglass boat manufacturers (about one quarter to one third) and at all aluminum boat manufacturers. The boat manufacturing NESHAP project is collecting information on these coating operations at both fiberglass and aluminum boat manufacturers. The EPA has not made a final decision, but is considering regulating coating operations at all boat manufacturers (except those regulated by the shipbuilding and repair NESHAP) under the boat manufacturing NESHAP to streamline the applicable NESHAP. Alternatively, boat manufacturing coating operations could be regulated under the plastic parts surface coating NESHAP or the miscellaneous metal parts NESHAP. Boat manufacturers would include those facilities that build hulls and decks of boats. Plastic parts facilities that only manufacture smaller boat parts (such as seat pedestals or bait boxes), as well as other plastic parts, would not be subject to the boat manufacturing NESHAP.

TABLE 3-1. POTENTIAL OVERLAPPING SOURCE CATEGORIES

Source Category	Regulations	Statutory Schedule	Scope of Regulation	Potential Overlap with Plastic Parts Surface Coating
Surface Coating of Miscellaneous Metal Parts	Section 183(e), BAC/CTG Section 112, MACT	2001 2000	Coatings applied to metal parts, including automotive and heavy duty truck parts.	Potential overlap would occur on heavy duty truck manufacturing lines, where many plastic and metal parts are coated simultaneously, with identical coatings.
Fiberglass and Aluminum Boat Manufacturing	Section 183(e), BAC/CTG Section 112, MACT	2001 2000	Manufacturing process, including application of coatings.	Coating of fiberglass boats is a plastic surface coating operation.
Reinforced Plastic Composites Manufacturing	Section 112, MACT	2000	Manufacturing processes, does not address coating.	Coating of reinforced plastic may be covered under plastic part surface coating.
Automobile and Light Duty Truck Assembly Coatings	Section 183(e), BAC/CTG Section 112, MACT	2003 2000	Coating of both metal and plastic parts for automobiles and light duty trucks that occurs <u>on the assembly line</u>.	Potential overlap with automotive plastic parts: a single plastic part may receive a prime coat off-site and a topcoat on the assembly line; parts may be coated at the assembly facility, but in off-line booths; parts coated off-site may receive touch up on the assembly line; coatings applied off- site must be color-matched with on-line coatings.
Surface Coating of Large Appliances	Section 183(e), BAC/CTG Section 112, MACT	2003 2000	Coatings applied to any large appliance part or product.	Some plastic parts and products at large appliance facilities may not fall within the scope of the large appliance rules; the plastic parts surface coating source category would be applicable to these parts and products.
Surface Coating of Metal Furniture	Section 183(e), BAC/CTG Section 112, MACT	2003 2000	Coatings applied to metal furniture parts or products.	Plastic parts may be added to the furniture prior to coating, or they may be coated at the same site.
Miscellaneous Industrial Adhesives	Section 183(e), BAC/CTG	2001	Miscellaneous industrial adhesives applied to a variety of substrates, including plastic.	Potential overlap with adhesives applications that are covered under plastic parts surface coating.

- Reinforced Plastic Composites Manufacturing. At this time, the reinforced plastic composites manufacturing source category covers the manufacturing process only, including preparation and clean-up but not including surface coating. Any surface coating of reinforced plastic composite parts and products will be addressed under the plastic parts NESHAP. The EPA is currently assessing the data needs for this sector.

- Automobile and Light Duty Truck Assembly Coating. Overlap between automobile and light duty truck assembly coating and plastic parts coating might occur for plastic automotive parts. However, the potential for a particular coating operation to be subject to rules for both categories can be eliminated by careful, coordinated development of the definitions of the affected facility in both rules. The automobile and light duty truck source category is intended to cover assembly line coating processes. The plastic parts source category is intended to cover automotive parts coated by contract coaters, but it also incudes parts coated at an automobile and light duty truck assembly facility if they are not coated on the assembly line. Ensuring the compatibility of the standards for the two source categories is also an important concern. For example, if a prime coat is applied off-line (therefore subject to the plastic parts standards) and a color coat is then applied to the same part on an assembly line (therefore subject to the automobile and light duty truck standards), the standards must accommodate a primer that compatible with the color coat. During the next phase of data collection, the plastic parts project will be gathering data from contract coaters and automotive part suppliers. The automobile and light duty truck assembly project will be gathering data from automobile assembly facilities that coat plastic products off the main assembly lines.

- Large Appliances. The large appliance source category includes any facility engaged in surface coating of any large appliance part or product, such as ranges, ovens, dishwashers, and water heaters. It is likely that some facilities produce plastic parts for large appliances and parts for other applications (perhaps using the same equipment or coatings). The small plastic appliances and other plastic parts not subject to the large appliances NESHAP will be subject to the plastic parts NESHAP. The large appliance project is responsible for gathering data from these facilities.

- Metal Furniture. The metal furniture source category includes any facility engaged in the surface coating of metal furniture parts or products, such as desks, tables, bookcases, and chairs. The scope includes paint mixing, cleaning, application, and adhesives. Some metal furniture may include plastic parts (for example, castors on a metal chair or plugs to cover rough edges on a metal shelving unit). If coated, these plastic parts may be attached to the metal furniture prior to coating. They may also be coated separately before assembly. The metal furniture project is gathering data from these facilities and will continue to coordinate with the plastic parts project team.

- Miscellaneous Industrial Adhesives. Volatile organic compound emissions from the application of miscellaneous industrial adhesives will be addressed under section 183(e) of the Act. The plastic parts source category currently includes adhesives applications for parts that are also surface coated. The EPA is still determining if adhesives application for parts that are not coated (for example, parts with molded-in color) will be covered if they are co-located with plastic parts coating operations. Adhesives application to plastic parts at facilities where coating does not occur will presumably be covered by the miscellaneous industrial adhesives source category. At this time, EPA is collecting data at facilities coating plastic parts and is obtaining data relevant to adhesives application at the facilities. Because of the way the survey recipients list was developed, data may also be collected for adhesives only facilities. Relevant data will be shared with the miscellaneous industrial adhesives project.

3.4.3 Overlap With Existing Rules

In addition to potential overlap with other source categories to be regulated under sections 112 and 183(e) of the Act, EPA has identified some potential overlap issues with other regulations. For example, the Federal Aviation Administration requires certain characteristics for interior parts of airplanes, such as chairs or wall panels. These requirements may specify that the part be flame resistant or give off no toxic fumes when burning. While not directly regulating the adhesives and coatings used, these requirements restrict which coatings and adhesives can be used.

The EPA is sensitive to the potential conflict between overlapping regulations for plastic parts, and is collecting data from coaters of plastic parts regarding any regulatory specifications that influence the choice of coatings used. The EPA is attempting through the industry survey to address overlap with any such programs, including: Federal Aviation Administration requirements, Food and Drug Administration requirements, Federal Communications Commission requirements, the requirements of the Safe Drinking Water Act, the requirements of the National Highway and Transportation Safety Act, National Transportation and Safety Board requirements, and Department of Defense military specifications.

In addition, some surface coating of plastic parts is currently regulated by New Source Performance Standards (NSPS). The NSPS is described in more detail in section 3.5. In general, the NSPS limits the amount of VOC in coatings that are applied to office equipment, laboratory machines, and computers. The NSPS applies to coating booths constructed after January 1986. "Business machines" is defined in the NSPS as:

> "...a device that uses electronic or mechanical methods to process information, perform calculations, print or copy information, or convert sound into electronic impulses for transmission."

Examples of business machines given in the NSPS include typewriters, electronic computing devices, calculators and accounting machines, telephone and telegraph equipment, and photocopy machines. Overlap with the business machines NSPS occurs because the plastic parts surface coating source category encompasses the NSPS affected facilities.

In addition to the business machines NSPS, there are other existing Federal rules which may overlap with the plastic parts and products source category. The EPA will continue to analyze these rules throughout the regulatory development to minimize duplicative or contradictory requirements. The rules that may overlap with plastic parts include the following:

- NESHAP for Aerospace Manufacturing and Rework Facilities, 40 CFR part 63, subpart GG;
- NESHAP for Wood Furniture Manufacturing Operations, 40 CFR part 63, subpart JJ; and
- Proposed National Volatile Organic Compound Emission Standards for Automobile Refinish Coatings, 40 CFR part 59 (62 FR 67784).

3.5 SUMMARY OF EXISTING FEDERAL AND STATE REGULATIONS

A number of existing Federal and State regulations address VOC content limits. Some related Federal rules for HAP have already been promulgated as well (as outlined in section 3.4.3). While some State air toxic programs may have ambient standards for certain HAPs found in coatings, HAP emissions specifically from plastic part coating operations are not regulated. Section 3.5.1 summarizes existing Federal rules (the business machines NSPS), and section 3.5.2 addresses existing State rules.

3.5.1 Federal Rules (Business Machines NSPS)

The NSPS to control VOC emissions from the coating of plastic business machine parts is found in 40 CFR part 60, subpart TTT. (The NSPS is included in appendix E of this document.) The NSPS sets VOC content limits for prime coats (1.5 kilogram/liter), color coats

(1.5 kilogram/liter), texture coats (2.3 kilogram/liter), and touch-up coats (2.3 kilogram/liter) in any facility constructed after January 1986 in which plastic parts are coated for use in manufacturing business machines. The standard defines the business machine sector as typewriters (SIC Code 3572), electronic computing devices (SIC Code 3573), calculating and accounting machines (SIC Code 3574), telephone and telegraph equipment (SIC Code 3661), office machines (SIC Code 3579) and photocopy machines (SIC Code 3861). Although subpart TTT defines EMI/RFI shielding coating, no VOC content limit is given. While the standard defines the affected facility as spray booths, all VOC emissions that are caused by coating application must be included in calculating a facility's compliance status (i.e., flash-off and curing emissions are also subject). Add-on control devices can be used as an alternative means of compliance, as determined on a case-by-case basis by the Administrator. If add-on controls are used, the owner or operator must demonstrate that the volume-weighted average mass of VOC emitted per unit volume of coating solids applied is within the applicable limit.

3.5.2 State Rules

In addition to Federal regulations, eight State and local air pollution control agencies have regulations to control VOC from facilities that coat plastic parts (Delaware, California, Illinois, Massachusetts, Michigan, New Hampshire, New York, and Tennessee). As would be expected, the States that regulate the coating of plastic parts are the States where this industry is concentrated. For example, California has many surface coating facilities generating plastic parts for the computer, transportation, and aerospace industries. Similarly, Michigan has a high concentration of plastic part surface coating associated with automobile manufacturing.

All of these State and local standards consist of a limit on the VOC content in coatings. These limits range from 1.2 to 7.1 pound/gallon, as the VOC content limits are a function of the part being coated (in some States). Appendix F summarizes the State and local plastic part surface coating rules.

Some of these regulations include specific work practices limiting VOC from cleaning and surface preparation as well as restrictions on the use of certain application equipment. All of the rules allow for the use of control devices to achieve a VOC reduction equivalent to the coating content limits. Currently, HAP content in plastic parts coatings is not regulated by any State.

The standards for Tennessee, Illinois, New Hampshire, and Michigan apply to coating operations for automotive and transportation equipment, business machines, and miscellaneous plastic parts. These rules further divide the automotive sector by coating cure temperature (high bake versus air dried), flexibility (flexible or nonflexible), and part location (exterior or interior). Tennessee, Louisiana, and Wisconsin follow the business machines NSPS. New York establishes a general coating limit for all plastic parts, and two air quality management districts in California (South Coast and Bay Area) have specific limits based on coating type.

Rules also exist for other coating processes in related industries. The EPA has issued a CTG for miscellaneous metal parts coating operations; issuing a CTG requires States under the Act to promulgate RACT standards for miscellaneous metal parts coating operations in ozone nonattainment areas. The format of the miscellaneous metal parts coating RACT standards for Tennessee, Illinois, New Hampshire, and Michigan are similar to their plastic part coating standards. These State rules include the same work practice standards and control device requirements for plastic parts coating operations and for miscellaneous metal parts coating operations.

4.0 REFERENCES

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